Supporting Information

Ionic liquid/ether-plasticized quasi-solid-state electrolyte for long-life lithium–oxygen cells

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Fig. S1. (a) XRD patterns and (b) SEM image of LATP powder.

Fig. S2. XRD patterns of the dry solid membrane.
Fig. S3. SEM image of IrO$_2$/MnO$_2$ on carbon cloth.
Fig. S4. (a) Photo and (b) XRD patterns of the Li anode after 90 cycles using QSSE with the TEGDME plasticizer. The Li foil was supported by Ni foam during the electrochemical cycling.

Fig. S5. Cycling performance of Li–O₂ cell with the QSSE plasticized by TEGDME. During the cycling, the failed Li anode was replaced by the fresh one and the cell was re-fabricated.
Fig. S6. Rate capability of the cells with different QSSEs.

Fig. S7. Voltage profiles of Li–O₂ cell with the TEGDME-plasticized QSSE in the initial cycle.
Fig. S8. Nyquist plot of the QSSE plasticized by (a) TEGDME, (b) PMIMTFSI, and (c) TEGDME/PMIMTFSI hybrid sandwiched between two stainless steel plates. The ionic conductivity ($\sigma$) of the QSSE was calculated from the equation of $\sigma = d/(R \times A)$, where $d$, $R$, and $A$ are the thickness, resistance and area, respectively, of the QSSE membrane. The measurement was conducted at room temperature.
Fig. S9. Photo of Li anode protected by PI film for XRD characterization.

Fig. S10. Structural formulas of (a) PMIMTFSI and (b) P(VDF-HFP).

Table S1. Comparison of cycling performance of solid-state Li–O₂ cells.

<table>
<thead>
<tr>
<th>Sample (matrix)</th>
<th>Current density</th>
<th>Capacity limitation</th>
<th>Cycle number</th>
<th>Ref.</th>
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<tbody>
<tr>
<td>PVDF-HFP/PPC/LATP</td>
<td>400 mA g⁻¹ catalyst⁻¹</td>
<td>1000 mA h g⁻¹ catalyst⁻¹</td>
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<td>This work</td>
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<td>ETPTA/HMPP/PVDF-HFP</td>
<td>100 mA g⁻¹ catalyst⁻¹</td>
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<td>P(PEGMA)/MTA/Silica</td>
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<td>500 mA h g⁻¹ MWCNT⁻¹</td>
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<td>PVDF-HFP</td>
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<td>500 mA h g⁻¹ catalyst⁻¹</td>
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<td>ETPTA/HMPP/GF</td>
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<td>PMS/PE</td>
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<td>1000 mA h g⁻¹ catalyst⁻¹</td>
<td>100</td>
<td>6</td>
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</table>

References

1 L. Xiao, E. W. Li, J. Y. Yi, W. Meng, B. H. Deng and J. P. Liu, Rare Met., 2018, 37, 527–535.

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